

CLAIMS

1. An apparatus for producing a single crystal comprising a crucible for holding a raw material, a heating device for heating the raw material in said crucible, and a crystal transporting device for transporting a seed crystal upwards from the inside of said crucible,

wherein the apparatus further comprises a heat conducting member which extends upwards at least from the vicinity of the upper end portion of the side wall of said crucible, which surrounds a formed single crystal, and which is made of a material having heat conductivity.

2. An apparatus for producing a single crystal comprising a crucible for holding a raw material, a heating device for heating the raw material in said crucible, and a crystal transporting device for transporting a seed crystal upwards from the inside of said crucible,

wherein the apparatus further comprises an interface portion radiation heat blocking member for blocking, at least during cooling after the formation of a single crystal, the radiation heat toward an upper portion above the interface portion between a taper portion, which is connected with a seed crystal of the formed single crystal and has a diameter gradually becoming increased, and a cylindrical straight body portion, which is connected with

the taper portion of the formed single crystal.

3. A method for producing a single crystal comprising the step of heating a crucible which holds a raw material and pulling up a seed crystal while the seed crystal is in 5 contact with a melt of the raw material so as to produce a single crystal,

wherein the diameter of the single crystal is increased during formation of a taper portion of the single crystal in an initial stage of growth of the single crystal, and the 10 single crystal is cylindrically grown connecting with the taper portion during formation of a straight body portion of the single crystal, while the radiation heat which reaches the taper portion of the single crystal from an inner surface of said crucible is blocked during the formation of 15 the taper portion of the single crystal.

4. An apparatus for producing a single crystal comprising a crucible for holding a raw material, a heating device for heating the raw material in said crucible, and a crystal transporting device for transporting a seed crystal upwards 20 from the inside of said crucible,

wherein the apparatus comprises an in-crucible radiation heat blocking member which surrounds a single crystal and which blocks the radiation heat from an inner surface of said crucible toward the single crystal 25 positioned in the inside of said crucible and an in-crucible

radiation heat blocking member transporting device for
transporting said in-crucible radiation heat blocking member
in a vertical direction, while said in-crucible radiation
heat blocking member transporting device transports said in-
5 crucible radiation heat blocking member to the position
surrounding a taper portion of the single crystal during
formation of the taper portion of the single crystal to
increase the diameter of the single crystal in an initial
stage of growth of the single crystal and transports said
10 in-crucible radiation heat blocking member to the position
at a distance from the single crystal during formation of a
straight body portion of the single crystal cylindrically
grown connecting with the taper portion.

5. A method for producing a single crystal comprising the
15 step of heating a portion in the side lower than the upper
end portion of a crucible which holds a raw material of a
single crystal and pulling up a seed crystal while the seed
crystal is in contact with a melt of the raw material so as
to produce a single crystal.

20 wherein the diameter of the single crystal is increased
during formation of a taper portion of the single crystal in
an initial stage of growth of the single crystal, and the
single crystal is cylindrically grown connecting with the
taper portion during formation of a straight body portion of
25 the single crystal, while the radiation heat toward an upper

portion above the upper end portion of said crucible is blocked during the formation of the straight body portion of the single crystal.

6. An apparatus for producing a single crystal comprising
5 a crucible for holding a raw material, a heating device for heating the raw material in said crucible, and a crystal transporting device for transporting a seed crystal upwards from the inside of said crucible,

wherein the apparatus comprises a straight body portion
10 radiation heat blocking member which can pass through a single crystal and which blocks the radiation heat toward an upper portion above the upper end portion of said crucible and a straight body portion radiation heat blocking member transporting device for transporting said straight body
15 portion radiation heat blocking member in a vertical direction, while the heating device heats a portion in the side lower than the upper end portion of said crucible, and said straight body portion radiation heat blocking member transporting device transports said straight body portion
20 radiation heat blocking member to the position at a distance from the upper end portion of said crucible during formation of a taper portion of the single crystal to increase the diameter of the single crystal in an initial stage of growth of the single crystal and positions said straight body
25 portion radiation heat blocking member in between the outer

perimeter surface of the straight body portion of the single crystal and the inner perimeter surface of said crucible or in between the outer perimeter surface of the straight body portion of the single crystal and the upper end portion of 5 said crucible during formation of the straight body portion of the single crystal cylindrically grown connecting with the taper portion.

7. An apparatus for producing a single crystal comprising a crucible for holding a raw material, a high-frequency 10 generation device including a high-frequency coil disposed surrounding said crucible, and a crystal transporting device for rotating and transporting a seed crystal upwards from the inside of said crucible,

wherein the apparatus comprises a wall-side heating 15 member for heating a portion in between the upper end portion and the lower end portion of the side wall of said crucible by the operation of said high-frequency generation device.

8. An apparatus for producing a single crystal comprising 20 a crucible for holding a raw material, a high-frequency generation device including a high-frequency coil disposed surrounding said crucible, and a crystal transporting device for rotating and transporting a seed crystal upwards from the inside of said crucible,

25 wherein the apparatus comprises a bottom-side heating

member for heating a central portion of the bottom by the operation of said high-frequency generation device, on the bottom of said crucible.

9. The apparatus for producing a single crystal,
5 according to Claim 7, wherein said wall-side heating member comprises a protrusion-shaped member which is made of an electrically conductive material and which is disposed in between the upper end portion and the lower end portion of the outer surface of the side wall of said crucible while
10 being extended along the circumferential direction of the outer surface of the side wall of said crucible.

10. The apparatus for producing a single crystal,
according to Claim 8, wherein said bottom-side heating member comprises a heat conducting portion made of a heat
15 conductive material for conducting heat to a central portion of the outer surface of the bottom of said crucible and a board-shaped heat generation portion which has a diameter larger than the diameter of the heat conducting portion and which is made of an electrically conductive material.

20 11. The apparatus for producing a single crystal,
according to Claim 8, wherein said bottom-side heating member comprises a heat insulating member made of a heat insulating material having a through hole at the position in accordance with a central portion of the outer surface of
25 the bottom of said crucible and a board-shaped heat

generation portion which has a diameter larger than the diameter of the through hole of said heat insulating member and which is made of an electrically conductive material.

12. A single crystal produced by the apparatus for
5 producing a single crystal or the method for producing a single crystal, according to any one of Claims 1 to 11.